A Survey of Lead-in-Soil from Seven Rural Communities in Manitoba, 1984

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A SURVEY OF LEAD-IN-SOIL CONCENTRATIONS FROM SEVEN RURAL COMMUNITIES IN MANITOBA, 1984

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ABSTRACT

Lead-in-soil concentrations were determined for samples collected from seven rural Manitoba communities during the summer of 1984. Lead concentrations were well below the Manitoba Environmental Management Division guideline of 2600 µg/g of lead. A slight trend toward higher lead concentrations adjacent to main thoroughfares was found. Lead concentrations were consistent with the range of background concentrations for lead in soil at other Manitoba communities.

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1. INTRODUCTION

Lead is introduced into our environment from many sources. Some of the major lead contributors are; exhaust emissions from the burning of leaded gasoline, emissions from the smelting industry, the use of products such as paints, lead solder used in cans for food storage and plumbing pipes.

It is well documented that exposure through inhalation or ingestion of high concentrations of lead may pose a health hazard, especially for young children (Rabinowitz et al 1985, Deluca 1984, Brunekreef 1983, Stark et al 1982, Needleman 1981, Coodin et al 1980, Peterson 1979, National Research Council 1978).

The Department of Environment and Workplace Safety and Health is concerned about lead contamination in Manitoba and has designed a program to monitor lead concentrations in surface soils of urban communities. The Environmental Management Division has adopted the Ontario Ministry of the Environment guideline for lead in soil. Removal of soil is recommended in residential areas or other areas frequented by children if lead-in-soil concentrations exceed 2600 µg/g.

A report "Lead Particulate Analyses in Air and Soil of The City of Winnipeg, 1982" was released by the Department in June, 1983 (Wotton and Doern 1983). A major conclusion of the report was that automobile exhaust emissions appeared to be the primary contributor to lead contaminated soil at Weston School, Winnipeg. In 1982 the Department initiated follow up action to expand monitoring in rural

communities of the Province. Initially the towns of Thompson and Flin Flon-Channing were surveyed for lead-in-soil concentrations (Jones 1983a, 1983b). In 1984 seven additional rural centres were evaluated. These nine communities represent the largest urban centres of the province outside the City of Winnipeg. The results of lead-in-soil surveys from the seven communities evaluated in 1984 are presented herein.

2. PROCEDURES

2.1 Rural Community Selection

Seven rural communities were selected for lead-in-soil sampling. The communities chosen represent some of the oldest and or largest population centres in rural Manitoba and therefore those likely to reflect the greatest buildup of lead in the soil. The communities selected for sampling were:

1. Selkirk
2. Steinbach
3. Portage la Prairie
4. Brandon
5. Dauphin
6. Swan River
7. The Pas.

2.2 Sample Collection

Sample sites at each community were located adjacent to and at various distances from major traffic thoroughfares to determine the concentrations of lead deposition as well as any pattern of deposition. The sampling design was intended to provide a collection of soils representative of the various areas of traffic flow for each community.

An Oakfield soil corer was used to sample sod (where available) and the upper 5 cm of surface soil. A series of 10 sample cores were taken at each collection site. Each series of 10 cores for both sod and soil were bulked separately and stored in clean plastic bags.

2.3 Sample Processing

Samples were taken to the W. M. Ward Technical Services Laboratory, 745 Logan Avenue, Winnipeg, where they were placed in acid washed glass beakers and oven dried at 100 °C for twenty-four hours. The dried samples were ground, using a mortar and pestle, to pass through a Canadian Standard #80 mesh sieve.

Between samples the mortar and pestle were rinsed with tap water and wiped dry with clean paper towels. Compressed air was used to blow fine soil particles from the sieve after which it was wiped with clean gauze pads.

The samples were analysed for total lead concentration by atomic absorption spectroscopy.

3. RESULTS

The concentrations of lead in sod and soil collected from the seven rural communities are presented in Table 1.

3.1 Selkirk

Figure 1 shows sample site locations for the Town of Selkirk. Lead concentrations in sod ranged from a low of 67 µg/g at site 1 to a high of 568 µg/g at site 2. Soil concentrations ranged from a low of 31 µg/g at site 1 to a high of 439 µg/g at site 8. Generally, lead concentrations were highest at sites along Provincial Highway 9A.

3.2 Steinbach

Sample locations for the Town of Steinbach are shown in Figure 2. In sod, lead concentrations ranged from a low of 31 µg/g at site 10 to a high of 328 µg/g at site 2. In soil, the lowest concentration was 138 µg/g at sites 4 and 12 and the highest 338 µg/g at site 7. There does not appear to be a clear pattern of deposition associated with the higher traffic volume along Provincial Highway 52. However, site 2 adjacent to the highway did have the highest lead concentration (328 µg/g) in sod.

3.3 Portage la Prairie

Figure 3 shows sample site locations for the City of Portage la Prairie. The lowest lead concentration in sod was 83 µg/g at

Table 1. Lead concentrations in sod and soil for seven rural Manitoba communities.

Sample #	Lead Concentration (µg/g)													
	Selkirk		Steinbach		Portage la Prairie		Brandon		Dauphin		Swan River		The Pas	
	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil	Sod	Soil
1	67	31	230	225	248	160	250	180	231	200	144	226	53	47
2	568	299	328	328	83	57	70	35	415	504	56	36	221	68
3	181	387	205	205	144	114	475	530	221	189	26	41	53	21
4	217	93	138	138	330	258	170	130	399	341	15	113	252	63
5	268	196	128	164	83	62	180	560	158	53	21	26	200	147
6	134	72	277	287	175	129	355	390	116	116	-	56	63	58
7	248	299	297	338	175	346	910	610	221	137	36	36	126	47
8	459	439	185	256	299	258	260	260	310	389	118	128	273	357
9	196	119	190	323	144	114	30	390	147	168	97	164	168	158
10	413	392	31	267	402	155	110	110	410	231	185	215	126	26
11	537	372	51	154	103	62	460	425	158	189	236	31	210	105
12	129	41	277	138	227	170	335	355	215	189	51	51	231	32
13	370	330			139	114	315	150	158	289	169	56	-	32
14	310	200			108	52	490	430	84	84			-	168
15	170	150			320	222	580	135					305	121
16					428	273	280	270						
17							190	150						
18							230	185						
19							460	310						
20							360	205						
21							115	190						
22							110	100						
23							375	265						
24							30	10						

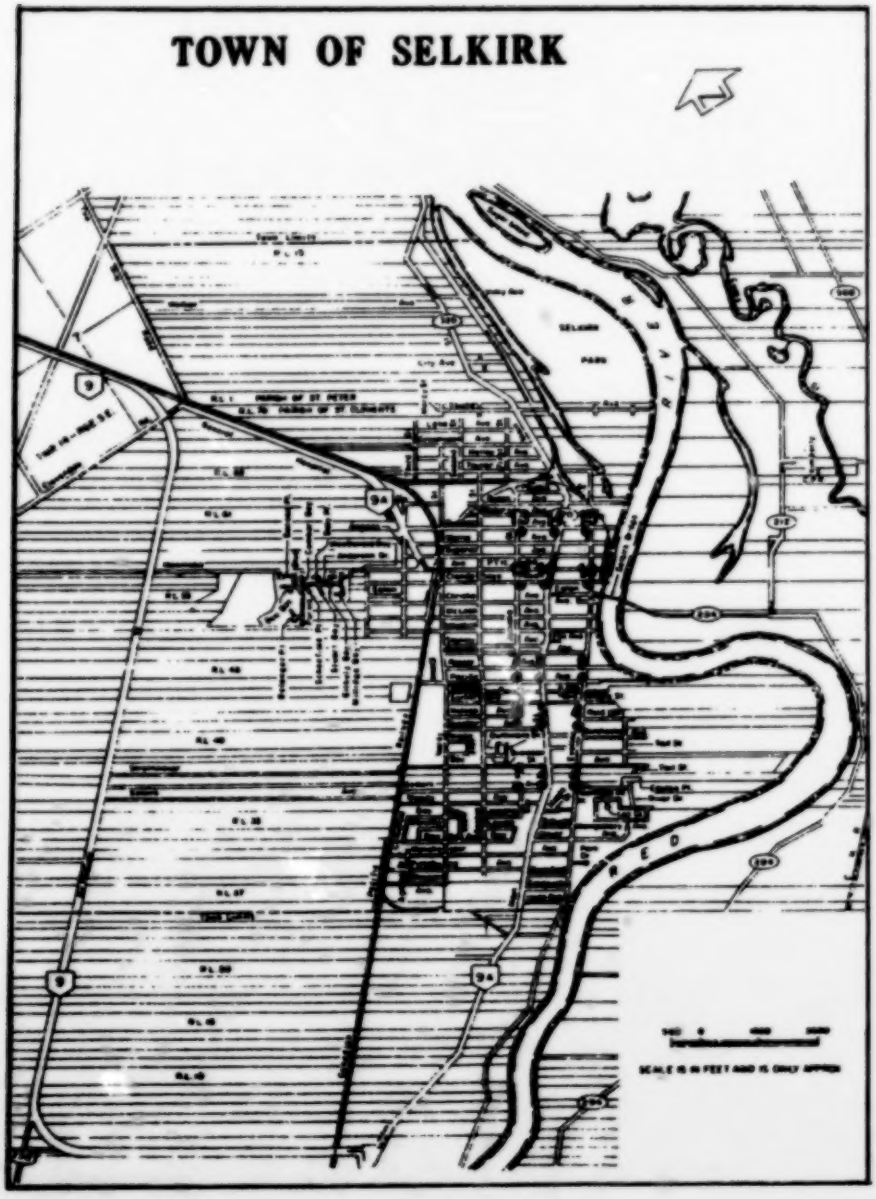
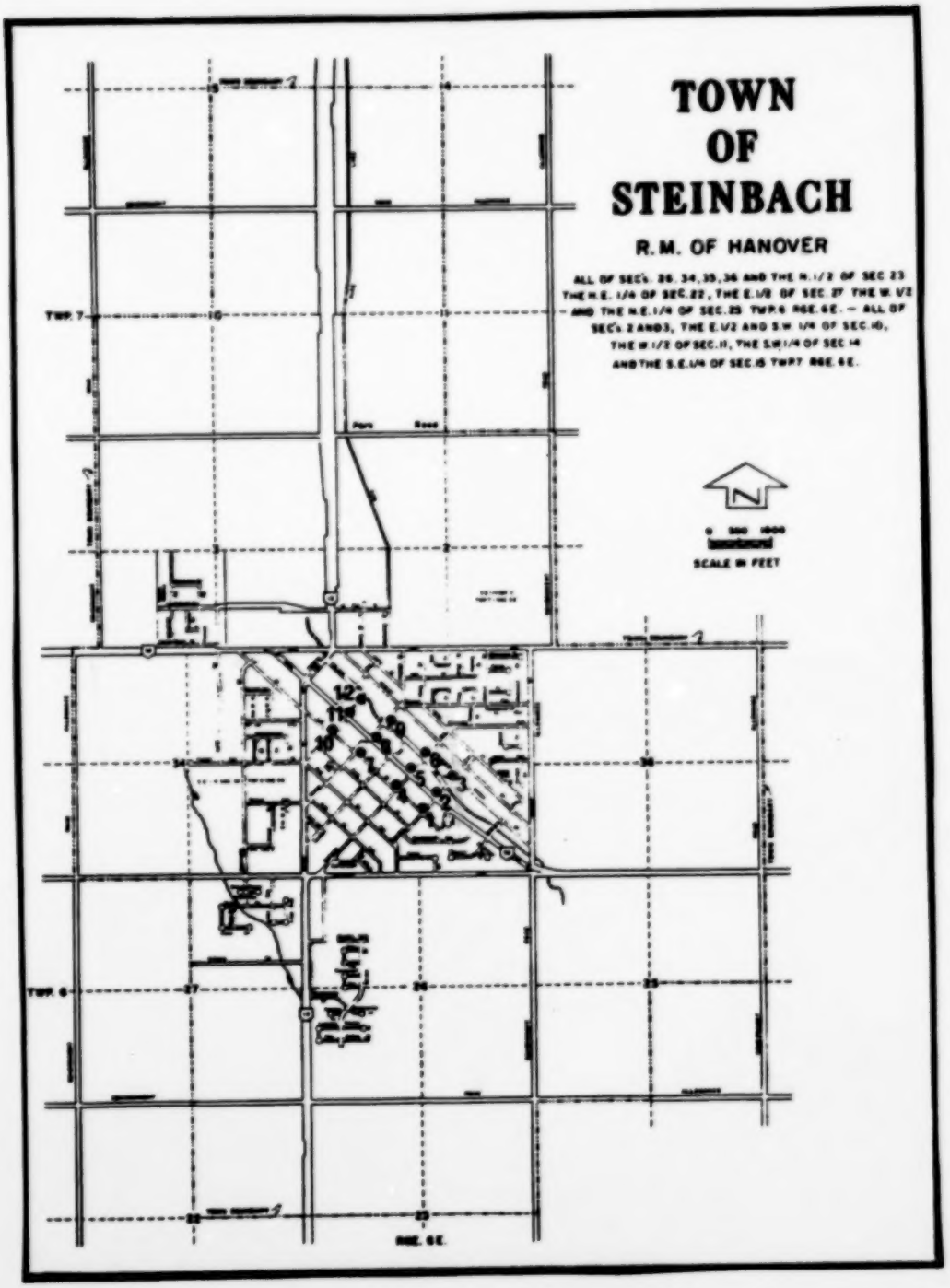


Figure 1. Map of sample locations for Selkirk


TOWN
OF
STEINBACH
R.M. OF HANOVER
ALL OF SECS. 28, 34, 35, 36 AND THE N. 1/2 OF SEC 23
THE N.E. 1/4 OF SEC. 22, THE E. 1/2 OF SEC. 27 THE W. 1/2
AND THE N.E. 1/4 OF SEC. 25 TWP. 6 RGE. 6E. - ALL OF
SECS. 2 AND 3, THE E. 1/2 AND S.W. 1/4 OF SEC. 10,
THE W. 1/2 OF SEC. 11, THE S.W. 1/4 OF SEC 14
AND THE S.E. 1/4 OF SEC. 15 TWP. 7 RGE. 6E.
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TWP. 7
TWP. 6
RGE. 6E.

Figure 2. Map of sample locations for Steinbach

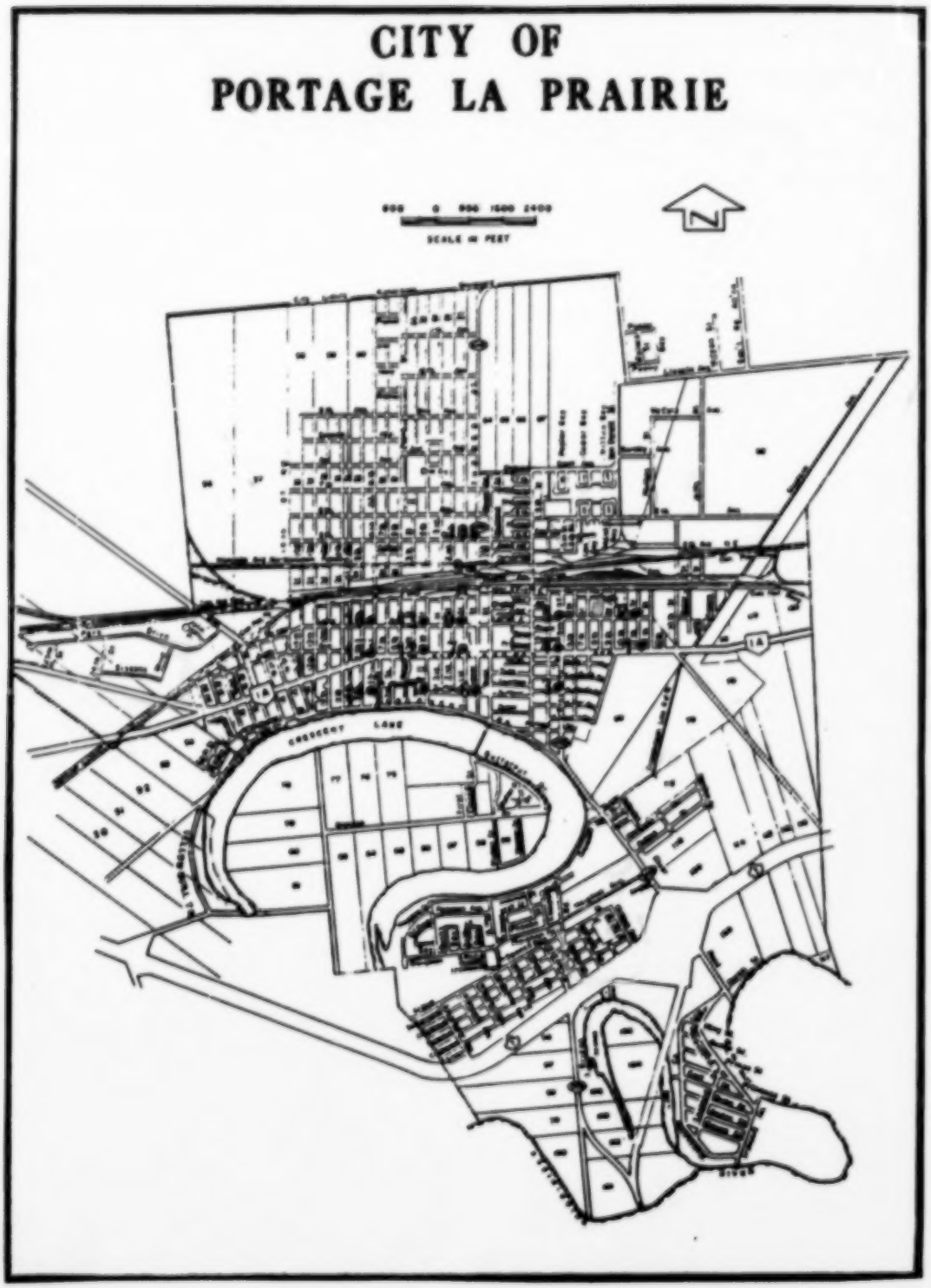

Figure 3. Map of sample locations for Portage la Prairie

sites 2 and 5 and the highest was 428 µg/g at site 16. Concentrations in soil ranged from a low of 52 µg/g at site 14 to a high of 346 µg/g at site 7. A slight trend toward increased lead concentrations at sites closest to Provincial Highway 1A was evident. This trend appeared to be stronger in soil than in the overlying sod.

3.4 Brandon

Sample locations for the City of Brandon are shown in Figure 4. Lead concentrations in sod were lowest at sites 9 and 24 at 30 µg/g each and highest at site 7 (910 µg/g). Lead concentrations in soil were lowest at site 24 (10 µg/g) and highest at site 7 (610 µg/g). There did not appear to be a consistent relationship between lead concentrations and the proximity to a major traffic route, Provincial Highway 1A. However, the highest lead concentrations in both sod and soil (910 µg/g and 610 µg/g) were found at site 7 along Highway 1A.

3.5 Dauphin

Figure 5 shows sample site locations for the Town of Dauphin. In sod, lead concentrations ranged from a low of 84 µg/g at site 14 to a high of 415 µg/g at site 2. Concentrations in soil ranged from a low of 53 µg/g at site 5 to a high of 504 µg/g at site 2. Again there does not appear to be a consistent relationship between lead concentrations and proximity to Provincial Highway 20A which has high traffic volumes. However, the highest concentration in sod and soil (415 µg/g and 504 µg/g) was found at site 2 located adjacent to Highway 20A.

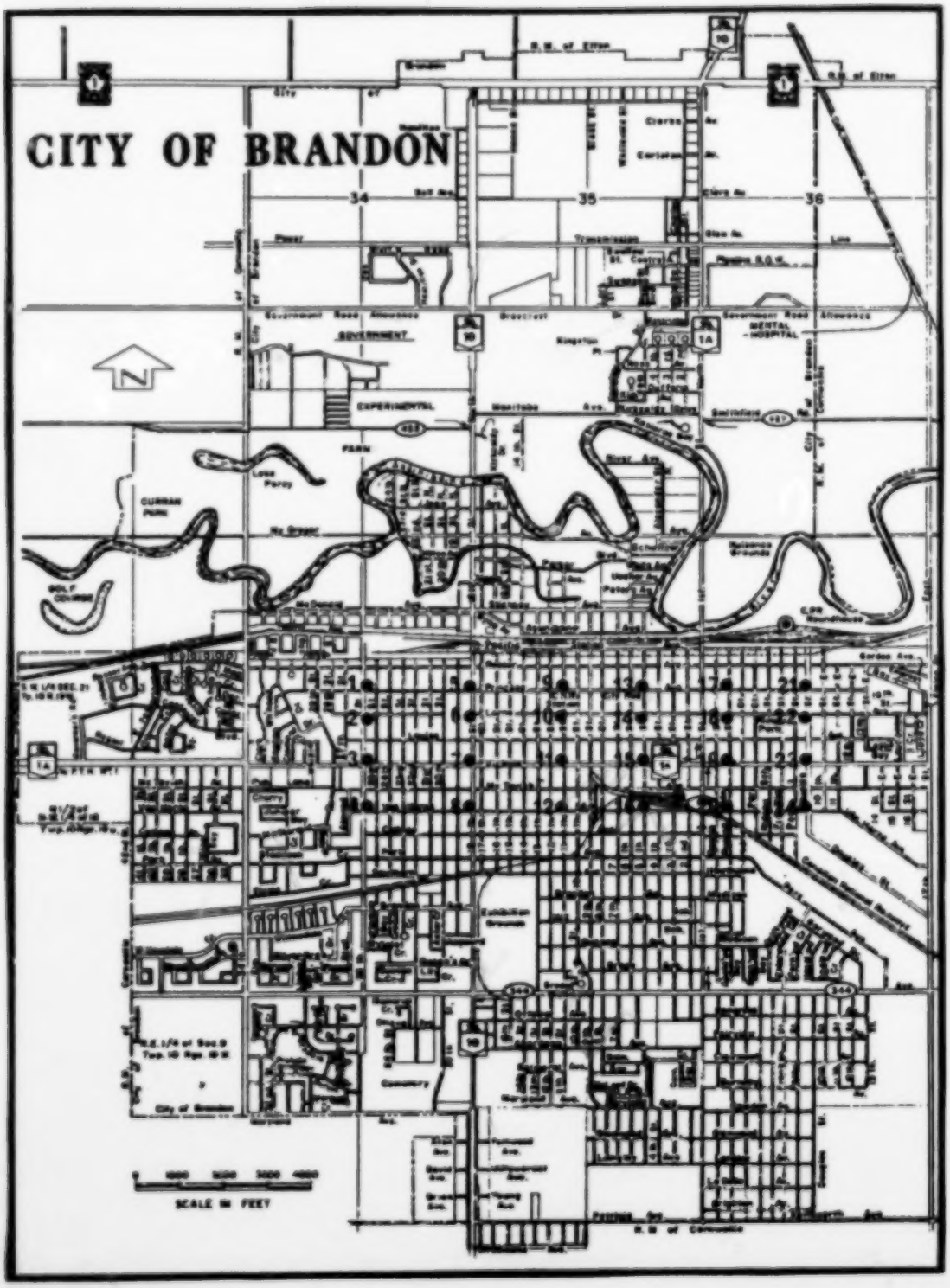

Figure 4. Map of sample locations for Brandon

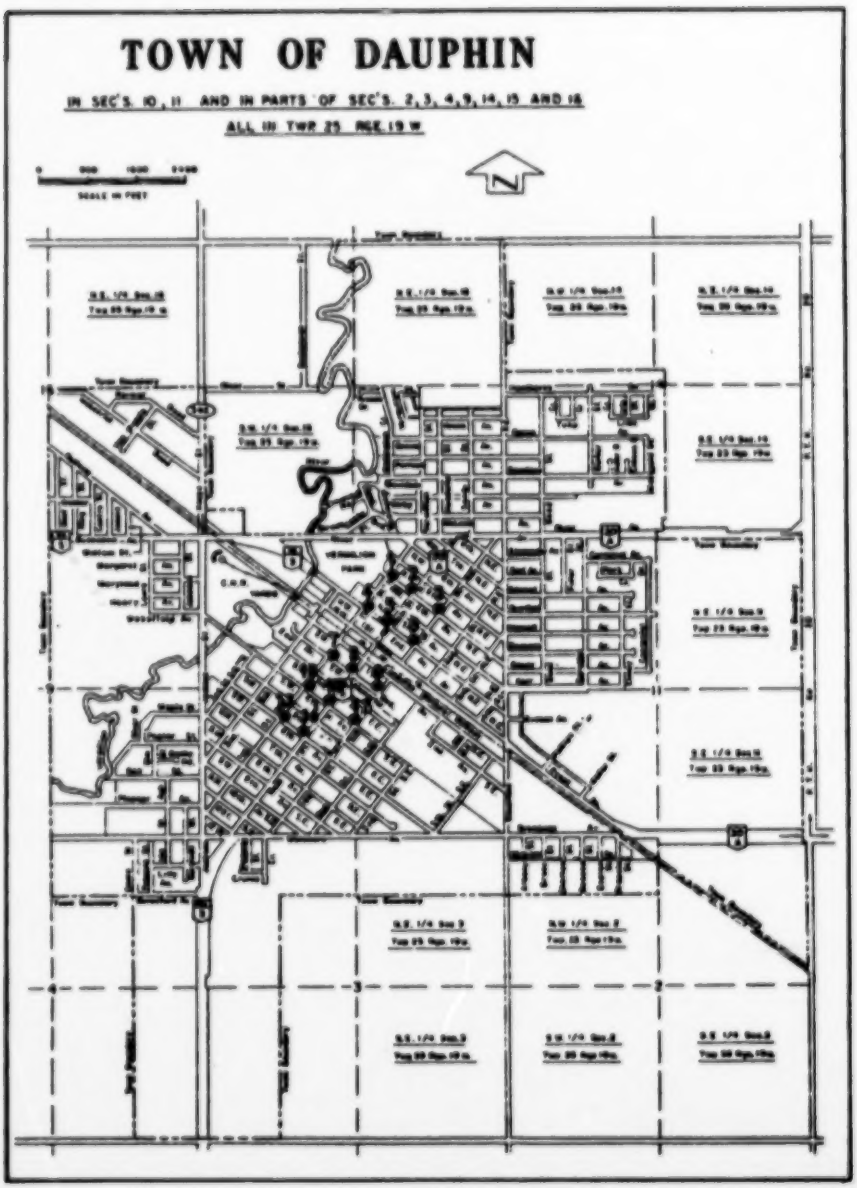

Figure 5. Map of sample locations for Dauphin

3.6 Swan River

Sample site locations for the Town of Swan River are shown in Figure 6. In sod, the lowest lead concentration was 15 µg/g at site 4 and the highest was 236 µg/g at site 11. In soil, the lowest lead concentration was 26 µg/g at site 5 and the highest was 226 µg/g at site 1. No consistent pattern of increased lead levels at sites closest to the main traffic route, Provincial Highway 10A, was evident. However, site 1, located along Highway 10A, did have the highest concentration in soil at 226 µg/g.

3.7 The Pas

Figure 7 shows sample site locations for the Town of The Pas. The lead concentrations found in sod ranged from a low of 53 µg/g at sites 1 and 3 to a high of 305 µg/g at site 15. Lead concentrations in soil ranged from a low of 21 µg/g at site 3 to a high of 357 µg/g at site 8. There was a general trend toward higher lead concentrations at sites close to the main traffic route, Provincial Highway 10. The highest concentration, in soil, (357 µg/g) was found at site 8 located adjacent to Highway 10.

4. DISCUSSION

A consistent and sharp gradient of reduced lead concentrations away from major vehicle routes has been reported in lead-in-soil surveys conducted in Winnipeg (Jones and Wotton 1983,

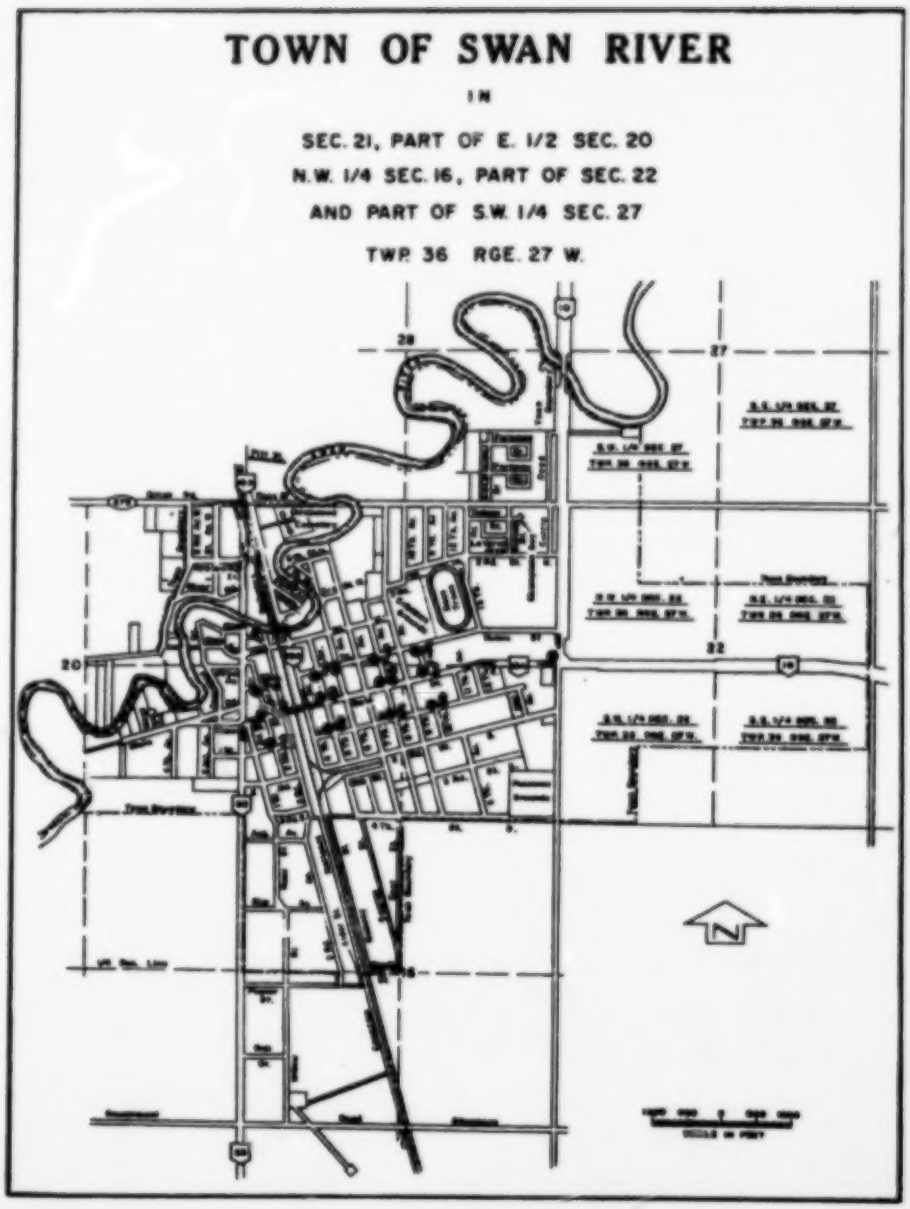

Figure 6. Map of sample locations for Swan River

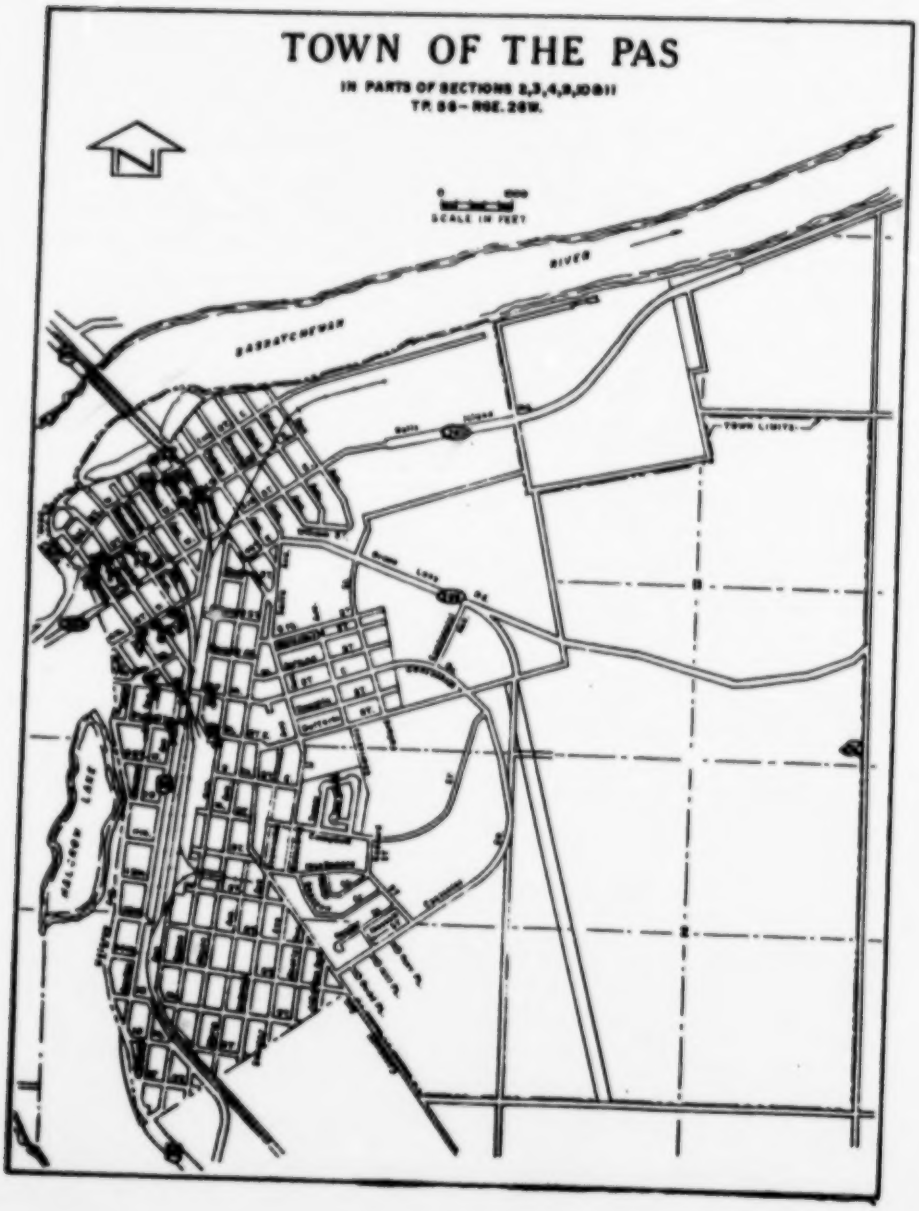

Figure 7. Map of sample locations for The Pas

Wotton 1980). This pattern of lead deposition is not as consistent nor is the gradient as sharp at most of the seven rural communities sampled. One possible explanation for this difference may be that these communities do not experience the rush hour traffic pattern that occurs in Winnipeg. Unlike Winnipeg, traffic in rural centers may utilize more secondary and residential routes during heaviest flow.

Lead concentrations found in the seven communities were consistently below the adopted standard of 2600 µg/g. In most cases lead-in-soil levels were comparable to background concentrations determined from surveys of the larger, more industrialized centres of Winnipeg, Flin Flon-Channing and Thompson (Jones and Wotton, 1983, Jones 1983a, 1983b).

5. CONCLUSIONS

1. All lead concentrations in the seven rural communities were well below the Environmental Management guideline of 2600 µg/g for lead in sod and soil.
2. The ranges in lead concentrations for the seven communities were consistent with other lead-in-soil studies conducted in Winnipeg, Thompson and Flin Flon.
3. Lead-in-soil concentrations for the seven communities were equivalent to background levels anticipated for an urban environment.
4. There was a slight trend of increased lead concentrations at sites located adjacent to major traffic thoroughfares.

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